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The Fishery for Blue Crabs in the St. Johns River, Florida, With Special Reference to Fluctuation in Yield Between 1961 and 1962

by Marlin E. Tagatz

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SPECIAL SCIENTIFIC REPORT–FISHERIES No. 501

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Special Scientific Report--Fisheries No. 501

Washington, D.C.
February 1965

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CONTENTS

	Page
Introduction	1
Life history of the blue crab	2
The river and the location of the crab fishery	2
The commercial fishery for blue crabs	2
Fishing gear	2
Regulations	4
Collection of data on catch and effort	4
Statistics of the fishery, 1961-62	5
Composition of the catch	7
Species composition	7
Sex composition	8
Width distribution	8
Width-weight relation	8
Minimum market size	9
Factors affecting size of catch	9
Summary	10
Acknowledgment	11
Literature cited	11

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ABSTRACT

The Bureau of Commercial Fisheries began studying the blue crab in 1957 to determine factors affecting the abundance of marketable-size crabs. In 1961 a field station for studying the blue crab and its fishery in the St. Johns River was established at Green Cove Springs, Fla.

A description of the commercial fishery for blue crabs in the St. Johns River is presented together with the statistics of the fishery for 1961 and 1962. The catch was 1,384,579 pounds in 1961 and 3,231,569 pounds in 1962 (an increase of 133 percent). The effort of fishermen fishing pots in 1962 was 68 percent greater than in 1961 and the effort of trawlers was 109 percent higher.

The factors primarily responsible for determining the size of the 1961 and 1962 catches were market conditions, migrations, and population size. Market conditions included changes in demand, the availability of outlets, and price. Movements of immature and mature crabs into fishing areas, and the length of stay, affected utilization by the fishery. Data on catch per standard unit of effort indicated fluctuations in population size between years.

Commercial catches were sampled during 1961 and 1962 to determine the sex ratio, width, and weight of blue crabs. Comparisons were made between unculled catches of crabs and those sold to dealers to define better the difference between the commercial marketable-size and the size of crabs actually caught.

INTRODUCTION

The blue crab, Callinectes sapidus, supports one of the most important fisheries of the United States. In 1961, 10,000 fishermen caught 153 million pounds of blue crabs valued at over $8 million to the fishermen. The blue crab ranges as far north as Nova Scotia but is found in greatest abundance from Delaware Bay to Texas. In Delaware and Chesapeake Bays, where year-round crab fisheries have long been established, more pounds of blue crabs are landed than of any other species of fish or shellfish except menhaden. More recently, a major fishery for blue crabs has developed in the South Atlantic States, where it is also second in poundage only to menhaden, and its dollar value, as a food species, is exceeded only by shrimp. The blue crab supports the most rapidly expanding fishery in Florida. A production of 25.6 million pounds in 1960 was four times that of 10 years ago and more than double that of 1957 (Rosen and Robinson, 1961).

Records of annual landings of blue crabs have been maintained since before 1900. Large and sudden fluctuations in supply have raised serious economic problems for the industry. Efforts to predict these fluctuations, or to control them by restrictive regulations, have been largely unsuccessful. Concerned over the instability of the crab supply, the Atlantic States Marine Fisheries Commission initiated action that resulted in a study of blue crabs in the South Atlantic States. The Bureau of Commercial Fisheries, as the primary research agency of the Commission, began this study in 1957 at its biological laboratory in Beaufort, N.C. To investigate the St. Johns River blue crab, a field station was established at Green Cove Springs, Fla., in 1961.

Studies were begun on the blue crab in the St. Johns River to determine the life history, the nature of the fishery, and natural factors that affect the size of the fishable population. This report is concerned primarily with the study of the fishery. The management of the fishery and the development of methods to predict yield require detailed statistics of fishing operations. Reliable catch and effort data are necessary in any attempt to determine year-to-year fluctuations in abundance when actual population size is not known. The contribution of factors that affect abundance can then be judged. Data on sex and size composition

Note.--Marlin E. Tagatz, Fishery Biologist (Research), Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C.

of the catch are useful in evaluating aspects of life history that have an immediate effect on the fishery. Knowledge of the fishery also can indicate factors that govern the size of the catch.

LIFE HISTORY OF THE BLUE CRAB

Knowledge of the life history of the St. Johns River blue crab, especially migrations of adults, is needed to understand the availability of crabs to the fishery.

Early development occurs in the ocean. The eggs hatch off the mouth of the St. Johns River from March through October, and the young go through a series of larval forms before they take on the appearance of the adult. Larvae reared in the laboratory went through seven zoeal stages over a period of 31-49 days; the one megalops stage lasted from 6 to 20 days (Costlow and Bookhout, 1959).

Young crabs migrate up the St. Johns River where they reach maturity in approximately a year. Crabs mate in the river, especially in waters of low salinity. After mating, the females migrate to the lower St. Johns River where they produce a sponge (egg mass on the abdomen); then they enter the ocean, where the eggs hatch. Many spent females return to the lower St. Johns River or adjacent river systems. Males may remain in the low-salinity areas or migrate downriver into high-salinity waters. Immature crabs move upriver and adult crabs downriver throughout the year.

THE RIVER AND THE LOCATION OF THE CRAB FISHERY

The St. Johns River watershed has an area of approximately 8,350 square miles. Headwater marshes are 50 miles north of Lake Okeechobee and 15 miles inland from Florida's east coast. The river flows north 260 miles to Jacksonville, after which it continues east 25 miles to the Atlantic Ocean. The St. Johns gradient of only about 20 feet gives the river a slow current. The usual head of tidal influence is Lake George, 115 miles upstream. During 1961-62, salinity readings 10 miles from the mouth of the river ranged from 2.5 p.p.t. to 33.4 p.p.t. They were lowest in late summer and early fall and highest in late spring. South of Jacksonville, 26 miles from the mouth, salinity is normally less than 1 p.p.t. Water temperatures in the lower river ranged from 8.2° to 34.1°C.

The commercial fishery for blue crabs beings 7 miles upstream and extends to Astor, Fla., approximately 135 miles upstream from the mouth of the river. The region encompassing the fishery was divided into three areas to facilitate investigation, as well as to allow comparison (fig. 1).

Area 1 extends 26 miles, from the mouth of the St. Johns River to the mouth of the Ortega River south of Jacksonville. The width in this area, for the most part, is less than 1 mile; the river is constricted at Jacksonville into what is termed the "narrows." Channel depth is 34 feet. North and south jetties extend from the mouth of the river about a mile into the ocean. The Intracoastal Waterway intersects the St. Johns River 5 miles from the mouth. The crab fisheries in the Waterway itself were located nearer other river systems and were not considered as part of the St. Johns River fishery. The first 7 miles of river have no fishery because of swift currents, regulations, and heavy boat traffic. The important tributaries for crabbing are Clapboard Creek and Trout River.

Area 2 encompasses 55 miles of river from the mouth of Ortega River upstream to Palatka, Fla. This area consists of a 1- to 3-mile-wide, shallow basin with a channel 13 feet deep. Much of the fishery in this area is located between Switzerland and Picolata. None of the tributary streams in this area supports significant crab fisheries.

Area 3 extends 54 miles from Palatka to Astor. The river in this area is narrow except for widening to 4 miles to form 14-mile-long Lake George, the largest lake in the river system. The average depth of Lake George is about 10 feet, and of the river channel 12 feet. Fishing for crabs in this area is concentrated between Welaka and the northern half of Lake George. The Oklawaha River and especially Crescent Lake support relatively important crab fisheries.

THE COMMERCIAL FISHERY FOR BLUE CRABS

Only adult hard crabs are taken in the year-round blue crab fishery in the St. Johns River. No soft-crab fishery has developed. Although most of the catch is sold to plants for processing, crabs also are sold alive to retail markets and to sport fishing camps for fish bait. Species of crabs other than the blue crab are not significant in the fishery.

Fishing Gear

Two types of gear are generally used for taking crabs in the St. Johns River--the crab pot and the shrimp trawl. The crab pot, the most widely fished, accounts for the bulk of the catch. Shrimp trawls are important only in Area 1. Catches of crabs by trawl may or may not be incidental to the capture of shrimp, depending on seasonal abundance and market demand for both species. Trotlines, dredges, scrapes, and fyke nets are rarely fished.

Crab pots are made of wood or wire (fig. 2) and are baited with scrap fish. The pots are

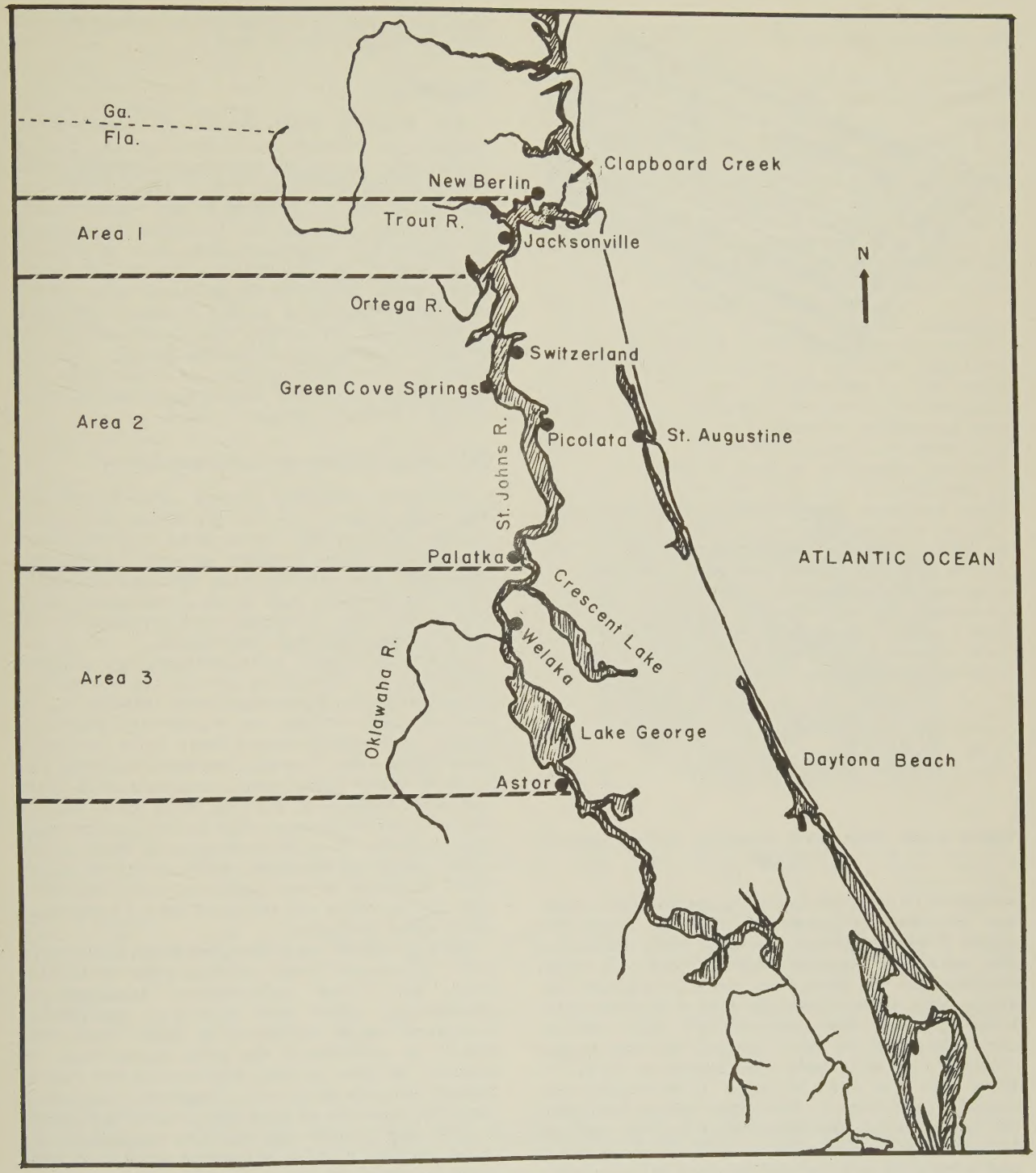

Figure 1.--St. Johns River, Fla., showing location (divided into three areas) of the commercial fishery for blue crabs.

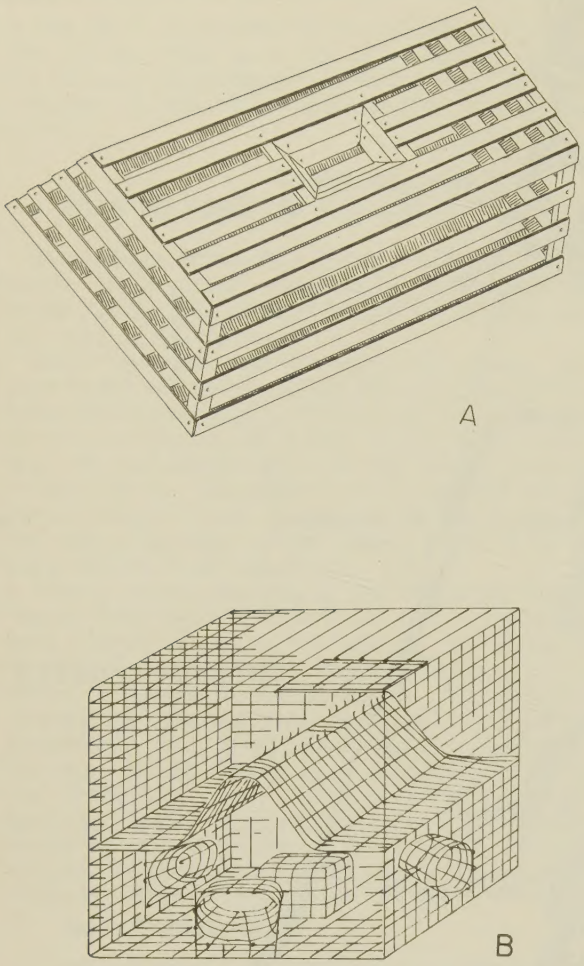

Figure 2.--St. Johns River crab pots. A, wooden pot; B, wire pot.

weighted to prevent tumbling on the bottom and are buoyed to designate location. Most St. Johns River crabbers operated 40 to 100 pots; the maximum number fished was 215. The wooden pot is fished in Area 1 because its shape and heavier weight give it greater stability against the current and wave action characteristic of this section of the river. Wooden and wire pots are fished in Area 2; wire pots are used in Area 3. Wire pots are usually preferred in localities where stability is not a factor because their lighter weight lessens the amount of work in fishing. Wooden and wire pots are treated together in this study.

Shrimp trawls fished for crabs in the St. Johns River are constructed of 1-1/2-inch stretched mesh, and are 35 feet across the mouth and 25 feet long. A few of the trawlers convert to a trawl of 2- or 2-1/4-inch stretched mesh when fishing for crabs. The trawl doors are attached to a bridle and single towing warp. Two men operate a single trawl from a motorboat no longer than 26 feet.

Regulations

The Florida State Board of Conservation imposed no regulations on the blue crab fishery during the period of this study (Florida State Board of Conservation, 1961). The operation of shrimp trawls is subject to gear and locality restrictions that indirectly affect the capture of crabs. The maximum legal size of a net is 35 feet wide and 25 feet long; nets can be fished only during daylight. In Duval County, which encompasses Area 1 of this study, no trawling is permitted downriver from Clapboard Creek or upriver from the Arlington Bridge in Jacksonville. The trawl fishery is confined to approximately 15 miles of river in Area 1; trawls take few crabs in Areas 2 and 3.

Collection of Data on Catch and Effort

Statistics obtained during 1961-62 on the blue crab fishery of the St. Johns River included catch by day, area, gear, and individual fisherman. The number of gear units per fisherman per day was also obtained. Initially, all crab dealers and crab fishermen were contacted; the program was explained and their cooperation was requested.

Most catch data were obtained by copying sales slips provided by processing plants and retail markets. Fishermen who retailed all or part of their catches were provided with logbooks in which to record their daily landings. Individuals who transported their catches and those of other fishermen to markets on the east and west coasts of Florida were given record books in which to enter each fisherman's catch. The records of each fisherman's daily catch were collected monthly. Records of the catch of all St. Johns River crabbers were obtained, with the possible exception of casual fishermen who fished few pots.

Data on effort were obtained from interviews with fishermen, from records kept by fishermen, and from information acquired by processing plant and market operators. Crabbers were contacted at least once each month to determine the area fished and the number of pots in use. Fishermen who maintained records of catch in logbooks also tabulated the number of pots lifted each day. Some processing plants and market operators entered on their sales slips the number of pots used by each fisherman. Effort was not recorded for every purchase but was entered often enough to aid in detecting changes in the amount of effort of individual fishermen. Dealers indicated on their sales slips the purchases from trawlers and thus helped us to follow the trawl fishing. The unit of effort for trawlers was considered as a trawl-day;

no attempt was made to determine the number of drags made during a day. A more precise standard unit of effort would be difficult to obtain because of wide variations in fishermen's selection between crabs and shrimp.

STATISTICS OF THE FISHERY, 1961-62

The catch and effort data in table 1 are presented by month to allow comparison of variations within and between years. Catch is in pounds; effort is in pot-days for the pot fishery and trawl-days for the trawl fishery. A pot-day represents one pot fished for 1 day. Designation of pounds per pot-day for a month or year represents the average catch of one pot fished for 1 day during the specified period. A trawl-day represents 1 day during which one trawl was operated, regardless of the actual number of tows. Pounds per trawl-day as presented for a specified period represents the average catch of one trawl fished for 1 day.

The production of blue crabs in the St. Johns River was 1,384,579 pounds in 1961 and 3,231,569 pounds in 1962 (an increase of 133 percent over 1961). Of the 1961 landings, pots accounted for 95 percent (1,314,243 pounds) and trawls, 5 percent (70,336 pounds); and of the 1962 landings, pots yielded 85 percent (2,746,598 pounds) and trawls, 15 percent (484,971 pounds). The increase in catch in 1962 over 1961 was 109 percent in pots and 590 percent in trawls.

In 1962, catch per unit of effort increased 26 percent in pots and 229 percent in trawls over 1961. Fifty-nine crabbers, in 1961, fished 303,781 pot-days and averaged 4.3 pounds per pot-day; in 1962, 109 crabbers fished 511,621 pot-days (an increase of 68 percent over 1961) and averaged 5.4 pounds per pot-day. Forty-seven trawlers, in 1961, fished 759 trawl-days and averaged 92.7 pounds per trawl-day; in 1962, 52 trawlers fished 1,590 trawl-days (an increase of 109 percent over 1961) and averaged 305.0 pounds per trawl-day.

The percentage of each month's contribution to the annual catch was similar in 1961 and 1962. Approximately 81 percent of the total catches in 1961 and 84 percent in 1962 were made in May through November. The monthly catch and effort of fishermen employing pots was lowest in March and highest in August each year. The largest number of pounds per pot-day was in November 1961 (5.3 pounds) and in August 1962 (6.5 pounds); the smallest catch was in March each year (2.8 pounds in 1961 and 2.7 pounds in 1962). Monthly catch of trawlers was lowest in January 1961 and in August 1962; catches were highest in June each year. The number of trawl-days was lowest in February 1961 and in August 1962. Trawl effort was highest in April 1961 and in May 1962. Catch per trawl-day was highest in June

Table 1.--Catch and effort statistics for the commercial blue crab fishery in the St. Johns River, Fla., 1961-62

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1961													
Pot													
Number of fishermen	14	15	19	36	41	47	49	46	41	42	41	30	59
Pounds of crabs	44,497	50,257	29,087	55,079	110,076	149,978	164,974	189,718	166,830	164,261	122,493	66,993	1,314,243
Number of pot-days	10,586	11,204	10,577	18,870	28,724	34,829	36,128	42,180	37,132	34,021	22,923	16,607	303,781
Pounds per pot-day	4.2	4.5	2.8	2.9	3.8	4.3	4.6	4.5	4.5	4.8	5.3	4.0	4.3
Trawl													
Number of fishermen	3	2	10	17	11	14	11	15	16	12	14	13	47
Pounds of crabs	1,154	1,745	3,016	4,452	5,347	16,740	13,714	5,354	2,819	2,924	3,127	9,944	70,336
Number of trawl-days	22	20	53	99	59	80	89	88	66	78	39	66	759
Pounds per trawl-day	52.4	87.2	56.9	45.0	90.6	209.2	154.1	60.8	42.7	37.5	80.2	150.7	92.7
Pot and Trawl													
Pounds of crabs	45,651	52,002	32,103	59,531	115,423	166,718	178,688	195,072	169,649	167,185	125,620	76,937	1,384,579
Percent of annual catch	3.3	3.8	2.3	4.3	8.3	12.0	12.9	14.1	12.3	12.1	9.1	5.5	100.0
1962													
Pot													
Number of fishermen	16	16	25	36	42	55	70	74	60	77	62	41	109
Pounds of crabs	29,658	24,672	19,365	113,546	180,395	241,909	473,624	528,125	390,676	425,602	232,083	86,943	2,746,598
Number of pot-days	7,314	7,250	7,204	27,817	41,374	55,858	76,558	81,742	63,110	75,671	48,186	19,537	511,621
Pounds per pot-day	4.1	3.4	2.7	4.1	4.4	4.3	6.2	6.5	6.2	5.6	4.8	4.4	5.4
Trawl													
Number of fishermen	21	19	19	22	27	25	22	5	12	19	20	15	52
Pounds of crabs	18,052	56,150	64,975	81,388	86,442	111,816	34,377	1,154	2,991	4,411	8,669	14,546	484,971
Number of trawl-days	106	161	141	220	272	246	150	15	29	72	98	80	1,590
Pounds per trawl-day	170.3	348.8	460.8	369.9	317.8	454.5	229.2	76.9	103.1	61.3	88.5	181.8	305.0
Pot and Trawl													
Pounds of crabs	47,710	80,822	84,340	194,934	266,837	353,725	508,001	529,279	393,667	430,013	240,752	101,489	3,231,569
Percent of annual catch	1.5	2.5	2.6	6.0	8.3	10.9	15.7	16.4	12.2	13.3	7.5	3.1	100.0

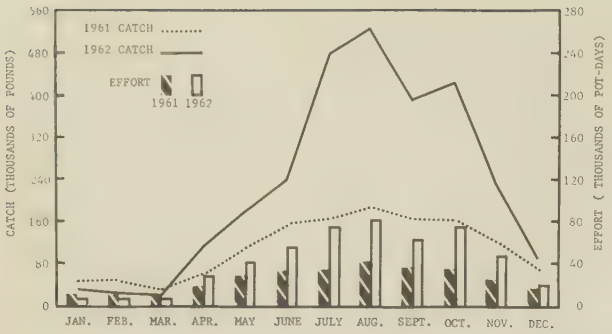

Figure 3.--Catch and effort of the pot fishery for blue crabs, St. Johns River, 1961-62.

1961 (209.2 pounds) and in March 1962 (460.8 pounds); in both years the smallest catches were in October (37.5 pounds per trawl-day in 1961 and 61.3 pounds in 1962).

The monthly fluctuations in catch and effort of fishermen employing pots (fig. 3) started from low catch and effort in January-March and rose steadily to a peak in August. After August, catch and effort progressively decreased (with the exception of an increase in October 1962) to the end of the year. The catch and effort were greater in 1962 than in the previous year for all months except January, February, and March. Differences between years in catch and effort were especially great from July through October. For each of these months the percentage increase of catch was greater than the percentage increase of effort.

Records of the pot fishery by area (table 2) show that the catch was largest in Area 3 in 1961 and in Area 1 in 1962. For both years, Area 3 had the highest level of effort. The pounds per pot-day differed by 0.2 pound between 1961 and 1962 for Areas 2 and 3, as compared to an increase of 4.0 pounds for Area 1. Of the three areas, only Area 3 showed a decrease in catch per pot-day in 1962.

The relation between catch and effort for each of the three areas for 1961 and 1962 is shown in figures 4, 5, and 6. The rate of increase in the catch for Area 1 in 1962 over 1961 was substantially greater than the rate of increase in effort. Increase in the catches for Areas 2 and 3 followed similar rates of increase in effort.

Table 2.--Monthly catch and effort data for the blue crab pot fishery in the St. Johns River, 1961-62
(Area 1, mouth - Ortega River; Area 2, Ortega River - Palatka; Area 3, Palatka - Astor)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1961													
Area 1													
Number of fishermen	6	6	8	9	9	8	8	5	5	6	6	5	12
Pounds of crabs	36,779	38,811	24,431	31,294	26,770	29,058	34,420	24,814	25,817	44,480	27,583	27,823	372,080
Number pot-days	8,975	8,815	9,380	10,864	10,104	8,669	7,825	6,059	5,725	8,094	5,924	4,711	95,145
Pounds per pot-day	4.1	4.4	2.6	2.9	2.6	3.4	4.4	4.1	4.5	5.5	4.7	5.9	3.9
Area 2													
Number of fishermen	6	7	9	12	15	18	19	17	17	18	18	13	22
Pounds of crabs	7,085	10,692	3,782	8,540	28,220	48,973	63,294	74,714	77,370	63,072	45,110	17,698	448,550
Number pot-days	1,233	2,029	849	2,224	5,838	9,693	12,224	12,863	11,904	11,338	8,542	4,344	83,081
Pounds per pot-day	5.7	5.3	4.5	3.8	4.8	5.1	5.2	5.8	6.5	5.6	5.3	4.1	5.4
Area 3													
Number of fishermen	2	2	2	15	17	21	22	24	19	18	17	12	25
Pounds of crabs	633	754	874	15,245	55,086	71,947	67,260	90,190	63,643	56,709	49,800	21,472	493,613
Number pot-days	378	360	348	5,782	12,782	16,467	16,079	23,258	19,503	14,589	8,457	7,552	125,555
Pounds per pot-day	1.7	2.1	2.5	2.6	4.3	4.4	4.2	3.9	3.3	3.9	5.9	2.8	3.9
1962													
Area 1													
Number of fishermen	7	7	7	6	5	10	15	18	18	19	15	9	27
Pounds of crabs	23,014	17,010	5,612	20,261	22,072	7,633	161,226	212,392	166,076	173,135	97,968	46,151	992,550
Number pot-days	4,608	4,061	1,657	4,645	4,226	7,810	16,078	20,318	19,964	21,666	13,314	7,390	125,737
Pounds per pot-day	5.0	4.2	3.4	4.4	5.2	6.1	10.0	10.5	8.3	8.0	7.4	6.2	7.9
Area 2													
Number of fishermen	5	4	7	10	16	21	23	24	15	32	29	22	40
Pounds of crabs	3,426	2,986	4,940	52,029	81,537	91,094	140,484	149,582	112,618	161,155	114,480	35,492	949,823
Number pot-days	1,313	1,180	1,750	10,771	15,363	18,799	21,139	21,648	13,095	26,936	26,880	9,981	168,855
Pounds per pot-day	2.6	2.5	2.8	4.8	5.3	4.8	6.6	6.9	8.6	6.0	4.3	3.6	5.6
Area 3													
Number of fishermen	4	5	11	20	21	24	32	32	27	26	18	10	44
Pounds of crabs	3,218	4,676	8,813	41,256	76,786	103,182	171,914	166,151	111,982	91,312	19,635	5,300	804,225
Number pot-days	1,393	2,009	3,797	12,401	21,785	29,249	39,341	39,776	30,051	27,069	7,992	2,166	217,029
Pounds per pot-day	2.3	2.3	2.3	3.3	3.5	3.5	4.4	4.2	3.7	3.4	2.5	2.4	3.7

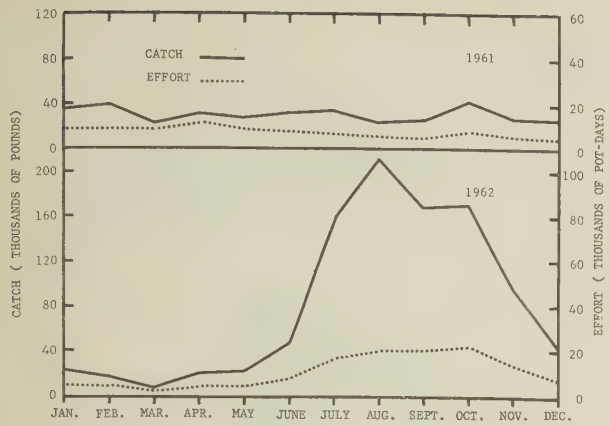

Figure 4.--Catch and effort of the pot fishery for blue crabs of Area 1, St. Johns River, 1961-62.

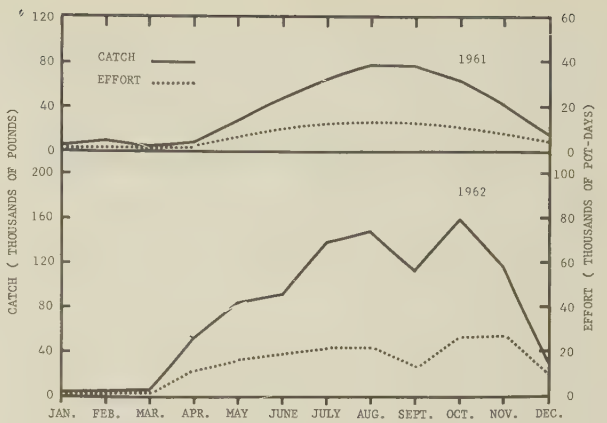

Figure 5.--Catch and effort of the pot fishery for blue crabs of Area 2, St. Johns River, 1961-62.

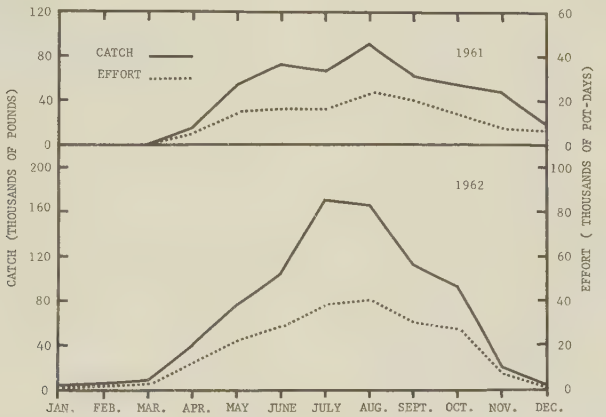

Figure 6.--Catch and effort of the pot fishery for blue crabs of Area 3, St. Johns River, 1961-62.

COMPOSITION OF THE CATCH

Commercial catches of crabs were sampled in 1961 and 1962 for species composition, sex ratio, carapace width, weight, and minimum market size.

Samples of approximately 150 crabs were taken from unculled catches. The pot fishery was sampled monthly in each of the three areas throughout the year. The trawl fishery was sampled when trawling for crabs was most productive. Observations were made also at the time the crabs were landed or at the time they were sold at market to supplement or confirm data obtained by sampling. Altogether, 80 samples (11,620 individuals) were taken from catches by pots, and 12 samples (1,655 individuals) from catches of trawls. Sex was determined, the carapace width of each crab was measured and about every fifth crab was weighed (2,488 individuals). The width was measured in millimeters between the tips of the lateral spines, and the weights were recorded in grams. Because there was no minimum size limit on crabs, comparisons were made between unculled catches of crabs and those sold, to define better the difference between the commercial marketable size and the size of crabs actually caught. From April through September 1961, 24 catches brought to processing plants were sampled to compare with 24 unculled catches obtained in the same localities at approximately the same time.

Species Composition

The catches in Area 1 contained other species of crabs, but because of their small size or infrequent occurrence, they had insignificant market value. The trawl catches commonly included one or more noncommercial species of the genus Callinectes in late spring to early fall. These crabs were of the forms described by Rathbun (1930) as Callinectes ornatus, C. danae, and C. marginatus. Because of the uncertainty of the taxonomic separation of this

group, as pointed out by Lunz (1958), representatives were collected but were not identified positively. These individuals, primarily juveniles, were too small (usually less than 100 mm.) to be of commercial importance and were not marketed. Occasionally the stone crab, Menippe mercenaria, and the portunid, Arenaeus cribrarius, were taken in the pot fishery. These forms were not culled from the catch but were marketed as edible crabs.

Sex Composition

Females made up the majority of the commercial catch in the fishery of the lower St. Johns River and males dominated in the upper river. In Area 1, the sex ratio varied with the season and between the area's upper and lower reaches. In the vicinity of New Berlin (fig. 1), for example, females made up 60 to 90 percent of the catch from January through September but only 10 to 25 percent from October through December. In the vicinity of Jacksonville, the percentage of females decreased from 75 percent in January and February to between 15 and 40 percent from April through October, and increased again to 75 percent in December. The ratios of females to males in Areas 2 and 3 varied little by location within the areas. The percentage of females in Area 2 shifted during the year from 10 to 35 percent, and in Area 3 from 5 to 35 percent.

Sponge crabs (females carrying an egg mass on the abdomen) were not seen in Areas 2 and 3 and generally were not common in the vicinity of Jacksonville in Area 1. Downriver from Jacksonville in the vicinity of New Berlin, however, the majority of the female crabs caught from April through September had sponges.

Width Distribution

Data on widths of crabs captured by pots, grouped into 10-mm. size classes, indicated that crabs 160-169 mm. were most common in catches from Area 1. Average widths of crabs were 157.9 mm. for Area 1, 155.4 mm. for Area 2, and 166.3 mm. for Area 3. The larger crabs (greater than 169 mm.) were most numerous in the pot catches of Area 3 and the smaller crabs (less than 150 mm.) were most common in the pot catches of Area 2 (fig. 7). The width of 16.5 percent of the crabs from Area 3 was 190 mm. or more. The largest crab measured was a 246-mm.-wide male from Lake George.

Widths of trawl-caught crabs had essentially the same width-frequency distribution as the crabs captured by pots in Area 1 (fig. 8). Differences are primarily the result of a greater percentage of crabs less than 120 mm. in the trawl catch.

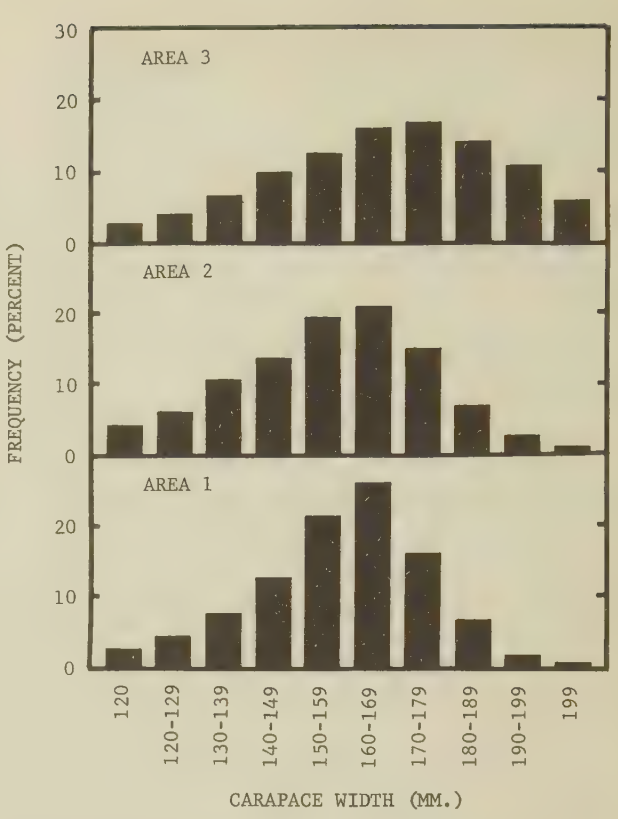

Figure 7.--Width distributions of blue crabs caught by the pot fishery of Areas 1-3, St. Johns River, 1961-62.

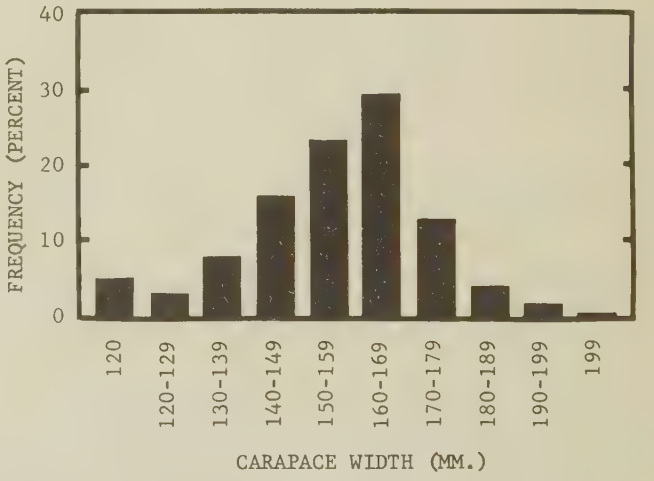

Figure 8.--Width distributions of blue crabs caught by the trawl fishery, St. Johns River, 1961-62.

Width-Weight Relation

Crabs that were weighed from the commercial fishery were grouped by 5-mm. width intervals, and the average weight was determined for each group. Individuals 100-mm. wide averaged 61 g. for males and 59 g. for

females; crabs 200-mm. wide averaged 398 g. for males and 272 g. for females. The heaviest crab was a 225-mm. male from the Oklawaha River that weighed 550 g. The weight advantage of males over females at a given size grew with increased width (fig. 9). The difference in weight was undoubtedly due to the generally longer lateral spines of females relative to the size of their bodies.

Weights given for females are exclusive of sponge. Comparisons of weights of sponge females and nonsponge females of the same widths revealed the sponge had an average weight of 37 g. (range 24-98 g.).

Minimum Market Size

Catches of crabs usually are not culled before they are taken to processing plants. Fishermen, especially trawlers, who handle their captured crabs individually may discard very small individuals, but the majority of pot fishermen dump the contents of each pot directly into receiving containers. Crabs smaller than 120 mm. did not comprise a large segment in the samples from unculled catches. Approximately 5 percent of the trawl catches and less than 5 percent of the pot catches contained crabs less than 120 mm. When catches do contain large numbers of small crabs, crab plants either refuse them or pay a lower rate. When small individuals are numerous, crabbers will cull their catches to ensure acceptance by the plant. Comparisons of widths of crabs brought to processing plants and of unculled catches at time of capture also indicated no appreciable amount of culling. Catches sampled at plants contained 6.9 percent of crabs less than 127 mm. and 3.3 percent of crabs less than 120 mm. Unculled catches consisted of 8.9 percent of crabs less than 127 mm. and 5.0 percent of crabs less than 120 mm.

Crabs sold by the fishermen directly to the public usually have been culled. Catches sold to retail markets generally are not culled; smaller crabs commonly are separated from the larger individuals and sold at a reduced price.

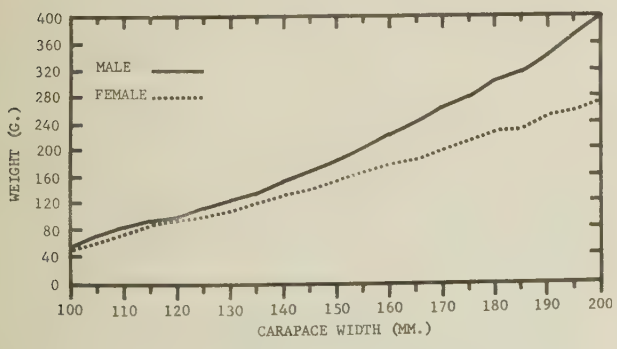

Figure 9.--Width-weight relation of crabs from the commercial fishery, St. Johns River, 1961-62. (Crabs are grouped to the nearest 5 mm., females are not in sponge.)

FACTORS AFFECTING SIZE OF CATCH

The factors primarily responsible for determining the size of the 1961 and 1962 catches were market conditions, crab migrations, and abundance. Variations in monthly catches among areas and between years could be accounted for by one or more of these factors.

The role of the market in regulating the size of the catch is based upon demand, availability of outlets, and price. The demand of processing plants for crabs largely determines the extent of utilization of the resource. Processing plants handled the majority of the 1961-62 catches and bought crabs from over half of the fishermen. The percentage of the catch handled by retail markets or retailed by the fishermen decreased more than half in 1962 (even though the catch was more than twice that of 1961) because sales through these outlets were limited by a fairly stable local consumer demand.

Utilization of crabs from other areas influences the demand for crabs from the St. Johns River. Processing plants along the river obtain crabs from the Nassau, Ft. George, Matanzas, North, and Indian Rivers, from the ocean, and from dealers on the west coast of Florida. The greater demand for St. Johns River crabs in 1962 than in 1961 resulted partly from a decrease in landings in other areas. The total catch of crabs in Florida was approximately 6,400,000 pounds less in 1962 than in 1961 (U.S. Fish and Wildlife Service, 1962). Improved local demand brings increased landings by encouraging increases in the number of fishermen, the number of gear units, and the time spent fishing. The large increase in the catch by trawls in 1962 resulted almost entirely from changes in market demand. Market operators readily purchased trawl-caught crabs in 1962 whereas in 1961 they preferred to buy pot-caught crabs (usually in better condition and fewer in sponge).

The addition of new market outlets for St. Johns River crabs during 1962 also increased landings. Crab fishing is generally localized where major market outlets are available, and new activity starts when new outlets arise. Fishing was more active in Areas 2 and 3 because truck operators transported crabs from these areas. A new crab plant built in Area 2 during the fall of 1962 had a further marked effect on the fishery. Fewer fishermen operated in September pending the opening of the new plant, which eliminated the need to haul their catches some distance to market. When the plant began full operation in October, the number of fishermen more than doubled and

the monthly catch in this area was the highest of the year.

Increase in the market price of crabs serves as another incentive for greater fishing. Fishermen some distance from market will start fishing when it is profitable to haul and deliver their catch. Many St. Johns River crabbers also fish for catfish, American shad, and shrimp. Market price determines the amount of effort employed for crabs relative to these other species. The present study yielded no evidence than an increase in the number of fishermen, such as occurred in 1962 over 1961, tended to decrease the catch of the individual fishermen in the St. Johns.

Migrations of immature and mature crabs determine their availability to the fishery, since fishing is usually localized. Movement into fishing areas and length of stay affect the extent of utilization.

The fishery of the upper river depends upon the migration upriver of juvenile crabs, and the length of time they remain as adults. Upon reaching maturity, females migrate almost immediately downriver. Most movements of mature males also are downriver but they may occur at once or over a number of months. Results of tagging and sampling in 1962 indicated that many juveniles terminated upstream migrations in Area 2 and, shortly after reaching commercial size, migrated to Area 1. The 1962 catch per unit of effort in Area 1 doubled over 1961 but changed little in Areas 2 and 3.

Fisheries of the lower river depend upon the movement of mature females from the river into the ocean to spawn, the return of females to the river after spawning, and the migrations of mature males from upriver. Mature females from upriver congregate in the lower river where they produce a sponge before entering the ocean. Those maturing during the summer migrate quickly from the upper river and into the ocean. Females maturing in fall and winter may remain for many months in the lower river; moving closer to the mouth and producing sponges with the coming of spring. The size, location, and time of these concentrations determine their utilization. Fishing success of downriver regions is also affected greatly by the number of females returning to the lower river after spawning and by the migration, especially during late fall, of mature males from upriver. Results of tagging and sampling indicated that the migrations of adults in 1962 were more favorable to the fishery of Area 1 than in 1961.

As in any fishery, an important factor in the size of the catch is the size of the catchable population. Large catches usually lead to greater effort at the time of good yield and, in the St. Johns River, for approximately a month after the catch has reached its peak. In winter a reduction in growth rate as a result of low temperatures reduces recruitment and the number of marketable-size crabs. A reduction in the activity of both crabs and fishermen during cold weather also accounts for smaller catches in this period.

No effective method has been devised to determine annual size of populations of marketable crabs. The catch per standard unit of effort gives an index of relative abundance. The substantial increase in this index in 1962 over 1961 for Area 1 (there was little change in Areas 2 and 3) indicate that an increased population in 1962 accounted in part for the greater catch of that year.

SUMMARY

The Bureau of Commercial Fisheries began studies on the blue crab in 1957 to determine factors affecting the abundance of marketable-size crabs. In 1961, a field station was established at Green Cove Springs, Fla., to study the blue crab and its fishery in the St. Johns River. Statistics on fishing in the St. Johns River are presented here for 1961-62, a period of marked fluctuation.

The commercial fishery for blue crabs begins 7 miles upstream from the mouth of the St. Johns River and extends to Astor, approximately 135 miles upstream. For this study the fishery was divided into three areas: Area 1, from the mouth of the Ortega River; Area 2, from the Ortega River to Palatka; and Area 3, from Palatka to Astor.

Crab pots of two types, wire and wood, are the most common gear used in the fishery. Lesser numbers of crabs are taken in Area 1 by trawls, often incidental to the capture of shrimp.

The catch was 1,384,579 pounds in 1961 and 3,231,569 pounds in 1962 (an increase of 133 percent). The catch of pot fishermen in 1962 rose 109 percent and effort increased 68 percent. The catch of trawl fishermen in 1962 was 590 percent greater than in 1961 and effort 109 percent higher. Monthly variations of catch and effort during each year and between years were described for each area.

Samples of commercial catches in 1961 and 1962 yielded data on sex and size composition of the catch. Females made up the majority of the commercial catch in the lower St. Johns River and males predominated in the upper river. Crabs 160-169 mm. dominated catches from Areas 1 and 2, and crabs 170-179 mm. were most frequent in catches from Area 3. Data are presented on other species of crabs caught, width-weight relations, and minimum market size.

Major factors that determined the size of the 1961 and 1962 catches were market conditions, migrations, and population size. Market demand, availability of outlets, and price regulated the amount of effort employed in the fishery. Movements of immature and mature crabs into fishing areas, and the length of stay,

affected utilization by the fishery. The number of marketable-size crabs affected effort and catch per unit of effort. All three factors contributed to increase in the 1962 catch of Area 1; the increase in the catches of Areas 2 and 3 resulted primarily from improved market conditions.

ACKNOWLEDGMENT

The cooperation of members of the crab industry and of individual fishermen in making catch and effort data available is gratefully acknowledged.

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